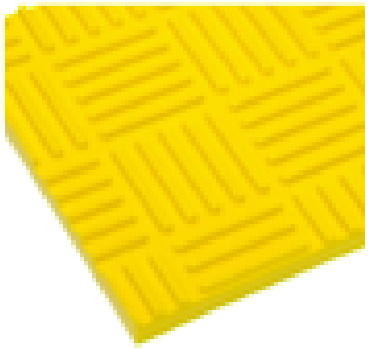
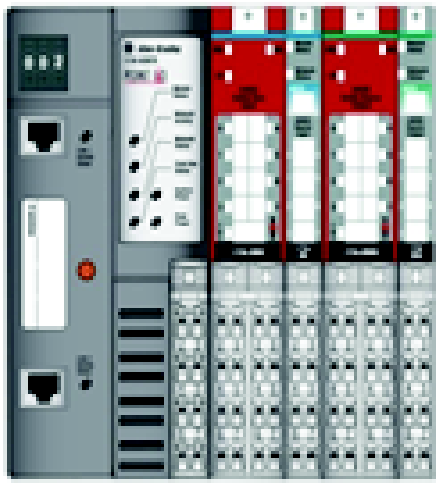
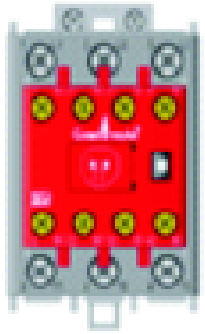
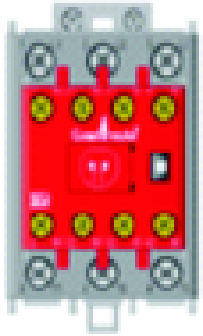
Application Technique









Safety Function: Safety Mat Stop

Products: Safety Mat, GuardLogix Controller
Safety Rating: CAT. 4, PLe to EN ISO 13849-1: 2008

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Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

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The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	**WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

	**SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	**BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
	**ARC FLASH HAZARD**: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

General Safety Information

Contact Rockwell Automation to find out more about our safety risk assessment services.

IMPORTANT	This application example is for advanced users and assumes that you are trained and experienced in safety system requirements.
	**ATTENTION:** Perform a risk assessment to make sure all task and hazard combinations have been identified and addressed. The risk assessment can require additional circuitry to reduce the risk to a tolerable level. Safety circuits must take into consideration safety distance calculations, which are not part of the scope of this document.

Table of Contents

Introduction

This safety function application technique explains how to wire, configure, and program a Compact GuardLogix® controller and POINT Guard I/O™ module to monitor a 440F safety mat.

This application technique assumes a dual-channel safety mat. It also assumes that the dual-channels are shorted together whenever the safety mat is stepped on. When this type of safety mat is wired directly into a safety input module, there is no way to distinguish between an actual wiring short between the two channels and stepping onto the mat. When either occurs, a short is created between the channels. For this reason, a machine stop must be the default state when the mat is stepped

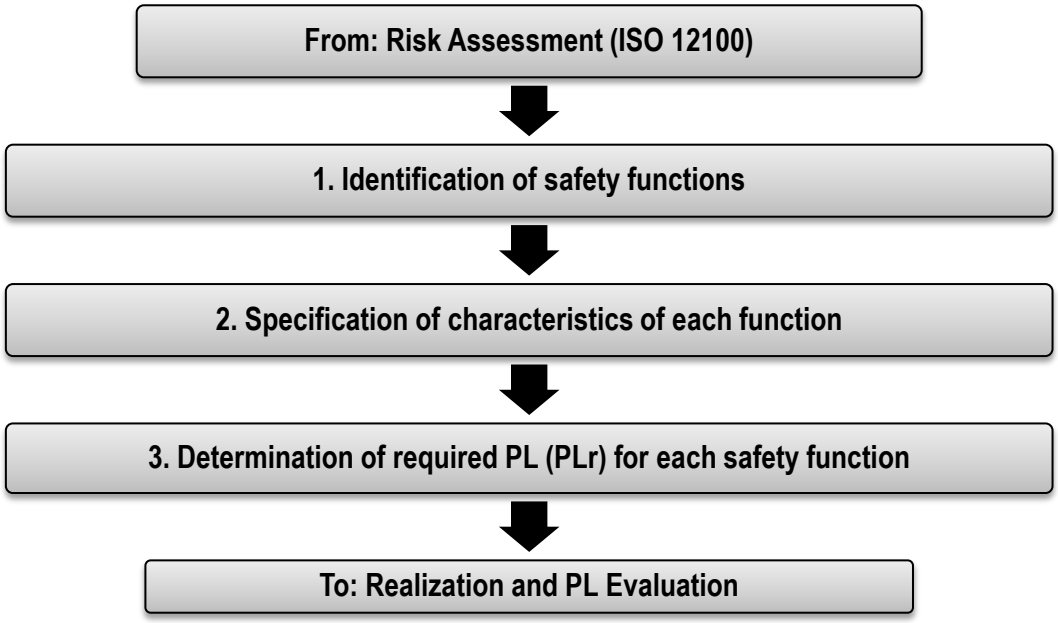
on. The machine can never start due to a channel-to-channel field wiring short. This would be possible if stepping onto the mat caused the machine to start.

If a demand is placed on the safety mat or a fault is detected in the monitoring circuit, the GuardLogix controller de-energizes the final control devices, in this case, a redundant pair of 100S contactors.

This example uses a Compact GuardLogix controller, but is applicable to any GuardLogix controller. This example also uses a 440F safety mat, but is applicable to any dual-channel safety mat that shorts the channels together when the mat is stepped on. The Safety Integrity Software Tool for the Evaluation of Machine Applications (SISTEMA) software calculations shown later in this document must be recalculated if different products are used.

Safety Function Realization: Risk Assessment

The required performance level (PLr) is the result of a risk assessment and refers to the amount of the risk reduction to be carried out by the safety-related parts of the control system. Part of the risk reduction process is to determine the safety functions of the machine. In this application, the PLr by the risk assessment is Category 3, Performance Level d (CAT. 3, PLd), for each safety function. A safety system that achieves CAT. 3, PLd, or higher, can be considered control reliable. Each safety product has its own rating and can be combined to create a safety function that meets or exceeds the PLr.



Safety Mat Safety Function

This application includes one safety function: a Category 0 stop by actuation of a safety mat.

Safety Function Requirements

Stepping on the safety mat stops and prevents hazardous motion by removing power to the motor. When the safety mat is reset, hazardous motion and power to the motor does not resume until a secondary action occurs—the Reset button is pressed and released. A fault at the safety mat, wiring terminals, or safety controller is detected before the next safety demand. The safe distance location of the safety mat must be established such that hazardous motion must be stopped before the user can reach the hazard. The safety function in this example is capable of connecting and interrupting power to motors rated up to 9 A, 600V AC. The safety function in this application technique meets or exceeds the requirements for Category 3, Performance Level d (CAT. 3, PLd), per EN ISO 13849-1 and control reliable operation per ANSI B11.19.

Functional Safety Description

Hazardous motion is interrupted or prevented by stepping onto the safety mat. The safety mat (SM1) is wired to a pair of safety inputs of a safety input module (SI1). The safety contactors (K1 and K2) are connected to a pair of safety outputs of a safety output module (SO1). The I/O module is connected via CIP Safety over an EtherNet/IP network to the safety controller (SC1). The safety code in SC1 monitors the status of the safety mat (SM1) by using the pre-certified safety instruction Safety Mat (SMAT). When all safety input interlocks are satisfied, no faults are detected, and the Reset button is pressed and released, a second pre-certified function block called Configurable Redundant Output (CROUT) controls and monitors feedback for a pair of 100S redundant contactors. In summary, when you step on the safety mat, the contactors drop out. When you step off the safety mat and the Reset button is pressed and released, the contactors are energized.

Bill of Material

This application uses these products.

Cat. No.	Description	Quantity
440F-M2020BYNN	Mat guard safety mat, 1000 x 1000 mm (3.3 x 3.3 ft), 4.5 m (14.8 ft) cables, yellow	1
800FM-G611MX10	800F reset push button - metal, guarded, blue, R, metal latch mount, 1 N.O. contact, standard	1
100S-C09ZJ23C	Bulletin 100S-C - Safety Contactors	2
1768-ENBT	CompactLogix™ EtherNet/IP bridge module	1
1768-L43S	Compact GuardLogix processor, 2.0 Mb standard memory, 0.5 Mb safety memory	1
1768-PA3	Power supply, 120/240V AC Input, 3.5 A @ 24V DC	1
1769-ECR	Right end cap/terminator	1
1734-AENT	24V DC Ethernet adapter	1
1734-TB	Module base with removable IEC screw terminals	4
1734-IB8S	POINT Guard I/O safety input module	1
1734-OB8S	POINT Guard I/O safety output module	1
1783-US05T	Stratix 2000™ unmanaged Ethernet switch	1

Setup and Wiring

For detailed information on installing and wiring, refer to the product manuals listed in the Additional Resources.

System Overview

The 1734-IB8S input module sources the 24V DC for both channels using two test outputs. The input module synchronizes the 24V DC for both channels using two safety inputs. The safety mat (SMAT) instruction toggles the test outputs (sources) so that they are always complementary (opposite). The SMAT instruction verifies that the inputs are always complementary.

When the mat is stepped on, a channel-to-channel short occurs and the high (1) channel has a path to both inputs. The SMAT instruction detects that the inputs are not complementary and drops the SMAT output.

Shorts to 0V DC, shorts to 24V DC, and wire breaks cause the toggling channels to operate improperly; therefore, making the fault detectable. The SMAT instruction sets the fault present (FP) output when any of these faults occur. After the fault is cleared, and the Reset button is pressed and released, the SMAT instruction can reset its output.

The final control devices, in this case, are a pair of 100S safety contactors (K1 and K2). The contactors are controlled by a 1734-OB8S safety output module. The contactors are wired in a redundant series configuration. A feedback circuit is wired through the N.C. contacts and back to an input on the input module to monitor the contactors for proper operation. If the feedback circuit is not in the correct state, the contactors cannot restart.

The system has individual Reset buttons for resetting faults and safety outputs.

In this example, the Reset buttons and the contactor feedback circuit are all wired to the input module. These three inputs can also be wired to a standard input module.

Safe Distance Calculation

Use this formula to calculate the size of the safety mat and its distance from the hazard. You need to use values based on your application rather than the example calculation shown here.

The select and use of pressure-sensitive mats/floors is dependent on the appropriate type-C standard or a risk assessment in accordance with ISO 14121-1, if no type-C standard exists. The minimum width of pressure-sensitive mats/floors shall be at least 750 mm to prevent the possibility of easy stepping over without actuation of the device. The minimum distances derived in this clause for pressure-sensitive mats/floors assume the approach speed to the hazard zone will be at walking speed (1600 mm/s). The minimum distance, S, in millimeters, from the hazard zone to the outermost edge of the detection zone of the protective device, shall be calculated using the following equation. S = (1600 x T) + 1200
Input
Safety Mat delay = 25 ms (from product documentation)
1734-IB8S input module delay = 16 ms (from product documentation)
Input module connection delay[1]

Safety controller delay[2]

- Safety Task Watchdog
- Safety Task Period

Output module connection delay[3]

1734-OB8S output module delay = 6 ms (from product documentation)

Contactor response time = 15 ms (from product documentation)

Actual machine stop time = assume 900 ms for this example

[1] The input module connection delay defaults to 4 x requested packet interval (RPI).
If we assume a RPI of 10 ms, the maximum delay = 40 ms

The worst case reaction time can be calculated by assuming there is only a single fault in the control system. This means that only the higher of the two connection delay values shown above needs to be included in the time (T) calculation. For this example, 40 ms is used, and the 30 ms is excluded. To account for multiple faults occurring at the same time, use both values in the calculation.

[2] The safety controller delay is a combination of the safety task period plus the safety task watchdog. The watchdog accounts for the possibility that the safety code runs right up to, but does not trip the watchdog. The safety task period accounts for the possibility that the asynchronous scan just ended when the input changed state. For this example, the following assumptions were made:

Safety Task Period = 10 ms

Safety Task Watchdog = 5 ms

To calculate T, add the following:

- Safety Mat delay = 25 ms
- 1734-IB8S module delay = 16 ms
- Higher of input/output module connection delay = 40 ms
- Safety controller delay = 10 + 5 = 15 ms
- 1734-OB8S delay = 6 ms
- Contactor response time = 15 ms
- Measured actual machine stop time = 900 ms

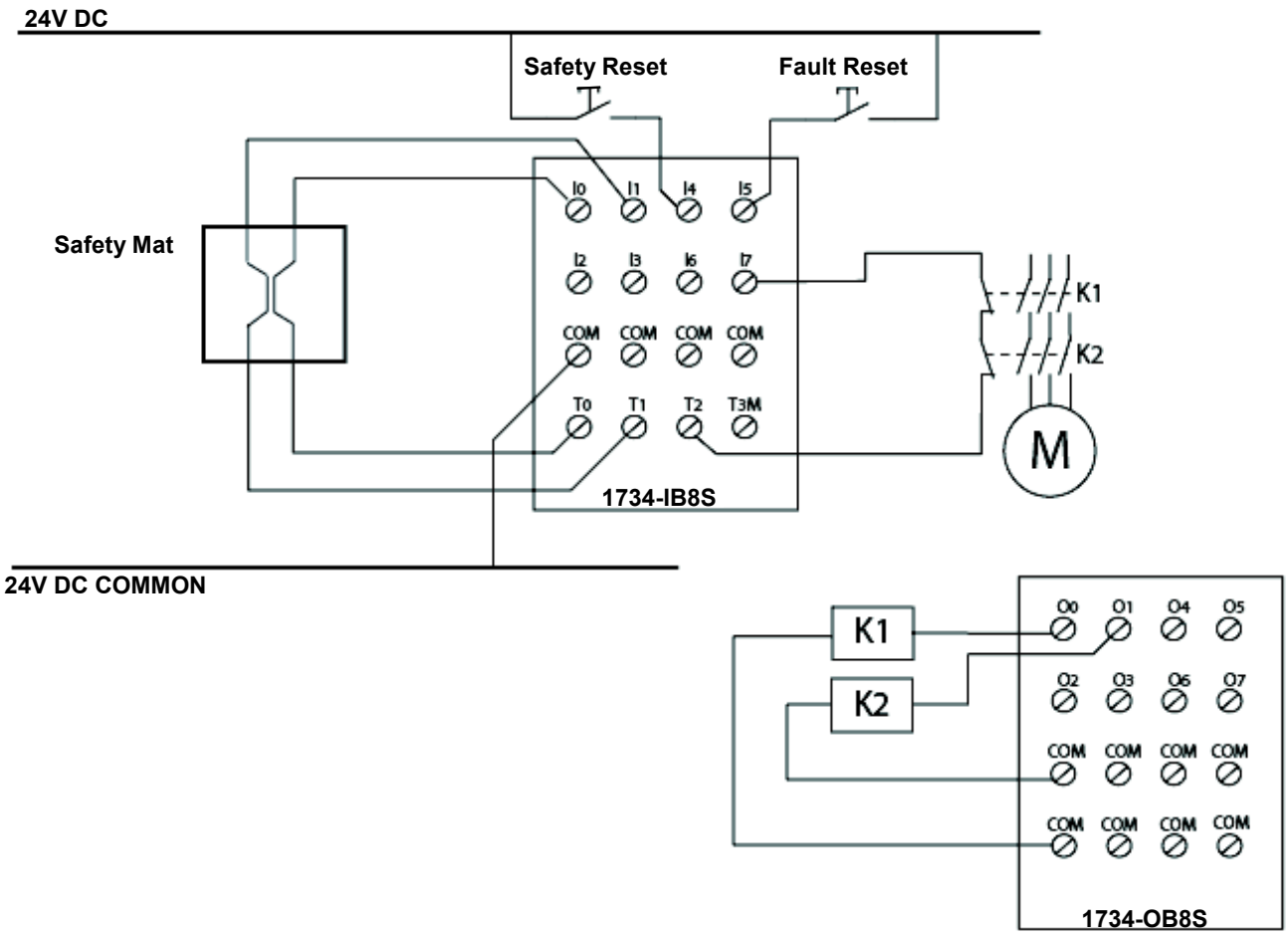
Therefore, the T in this example is 1017 ms.

S = (K * T) + C – 0.4H = (63 * 1.017) + 47.2 - 0 = 111.27 in.

Conclusion: The safety mat's far edge must be placed 111.27 in. away from the hazard.

[3] The Output Module connection delay defaults to 3 x RPI.
If we assume an RPI of 10 ms, the maximum delay = 30 ms.

Electrical Schematic

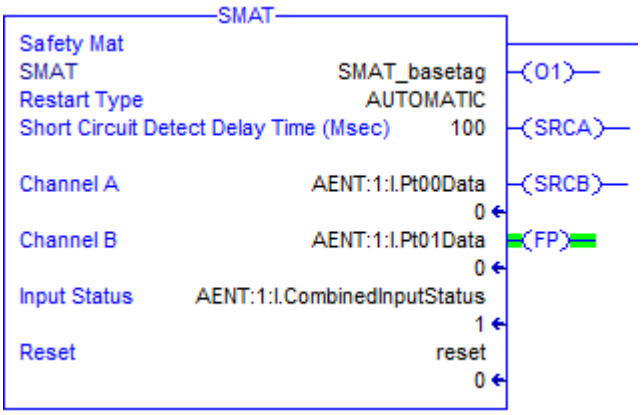


Configuration

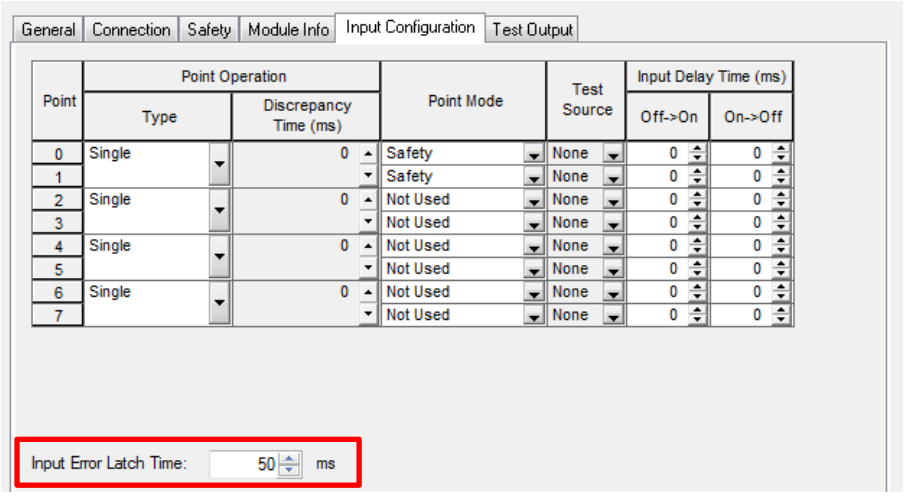
The Compact GuardLogix controller is configured by using RSLogix™ 5000 software, version 17 or later. First, you must create a new project and add the I/O modules, then configure the I/O modules for the correct input and output types. A detailed description of each step is beyond the scope of this document. Knowledge of the RSLogix programming environment is assumed.

Configure the SMAT Instruction

The short-circuit detect delay time (SCDDT) is the amount of time (ms) the ` (SMAT) instruction waits before declaring that the two high (1) channels at the safety inputs were caused by a fault and not someone stepping on the mat. When the mat is stepped on, the SMAT instruction sees the high (1) equivalency at the inputs and sets the test outputs low (0). Because both channels were high (1) and now both are low (0) before the SCDDT timer expires, the SMAT instruction is notified that someone has stepped on the mat. Any other channel reaction is an indication that some other fault has occurred. Therefore, SCDDT must be longer than the time it takes for SMAT instruction to attempt to reset both channels. The minimum delay for SCDDT is 5 ms. If the SMAT instruction is in the continuous task, that is sufficient enough to accomplish this task. This delay has no effect on the safety reaction time. The output goes low (0) immediately when the short occurs, regardless of SCDDT. Basically, the SCDDT is the length of time before a fault is declared.

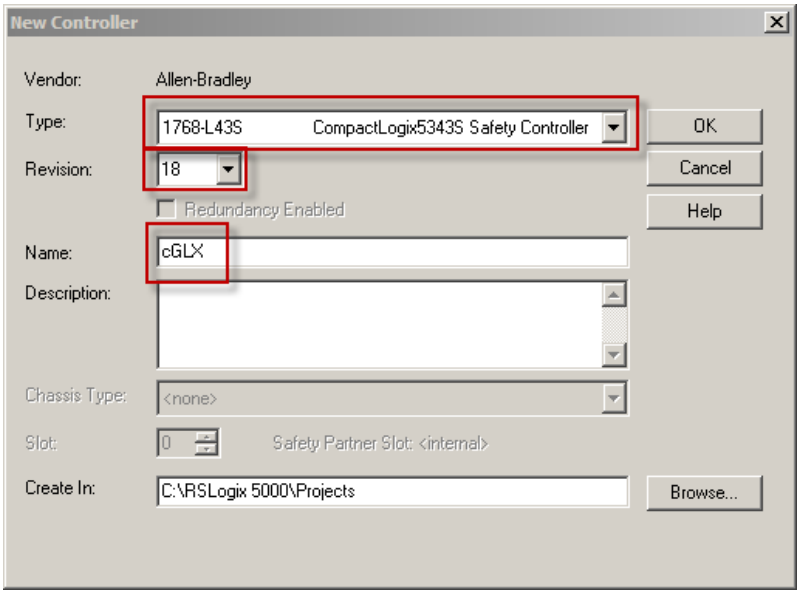


The input-module error-latch time (IELT) is shown in the image below. The IELT is the time the input-module test output-fault remains before the module allows the IELT to be reset. If the IELT is longer than the SCDDT, the test output fault always remains when the SCDDT expires, and that causes the SMAT instruction to declare a fault every time someone steps on the mat. Therefore, the SCDDT must be greater than the IELT. In the image shown above, the SCDDT is set to 100 ms. In the image shown below, the latch time is set to 50 ms.

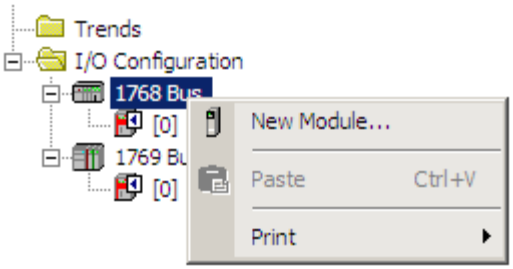


Configure the Controller and Add I/O Modules

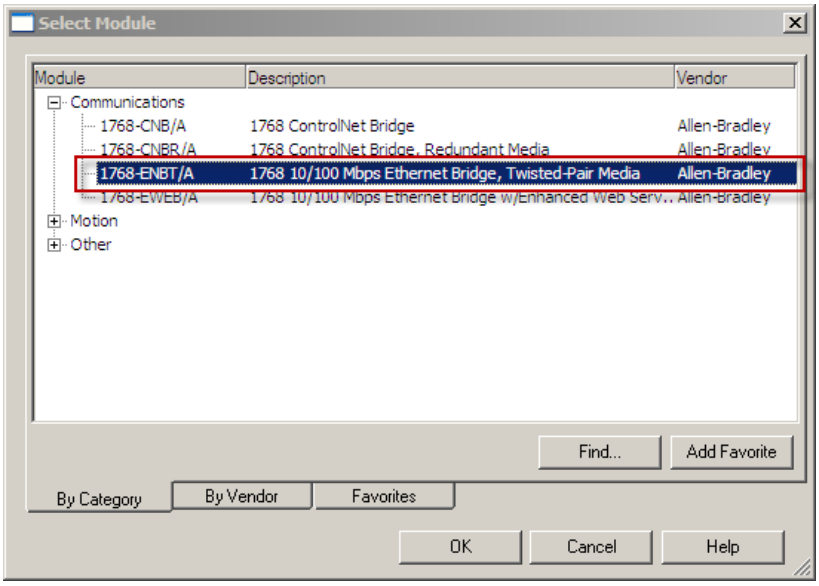
1. In RSLogix 5000 software, create a new project.
2. Choose a controller.
   a. From the Type pull-down menu, choose 1768-L43S CompactLogix 5343S Safety Controller.
   b. From the Revision pull-down menu, choose the appropriate revision for the controller.
   c. In the Name box, type an appropriate name for the controller.
   d. Click OK.



3. In the Controller Organizer, right-click 1768 Bus and choose New Module.

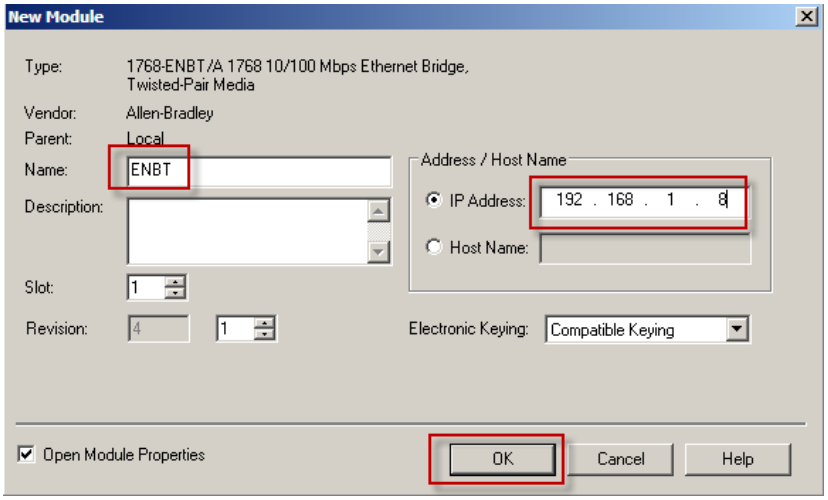


4. Select the 1768-ENBT/A module and click OK.

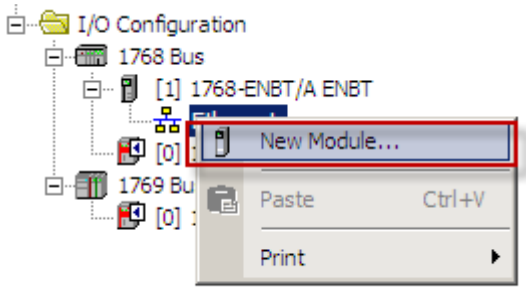


5. Name the module, type its IP address, and click OK.

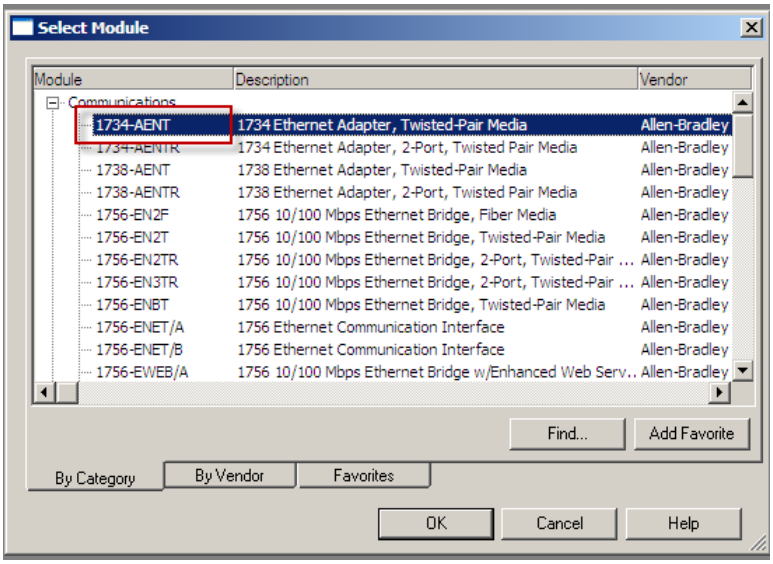
   For this application, we used 192.168.1.8; however, your IP address can be different.



6. In the Controller Organizer, right-click the Ethernet network and choose New Module.

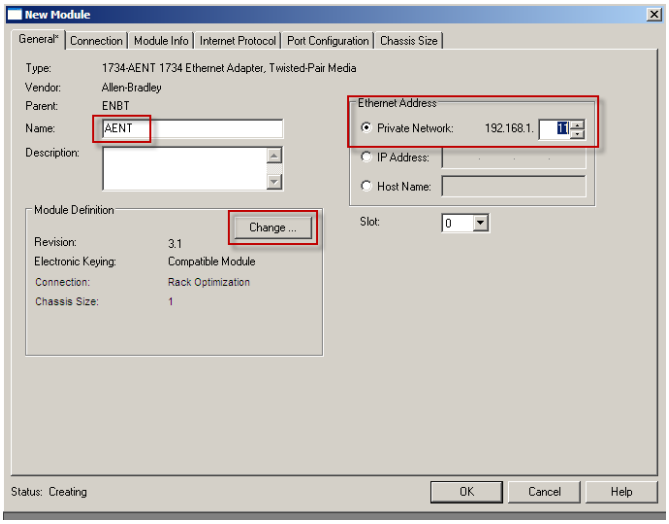


7. Select the 1734-AENT adapter and click OK.



8. Name the module and choose its IP address.

   For this application example, we used 192.168.1.11; however, your IP address can be different.

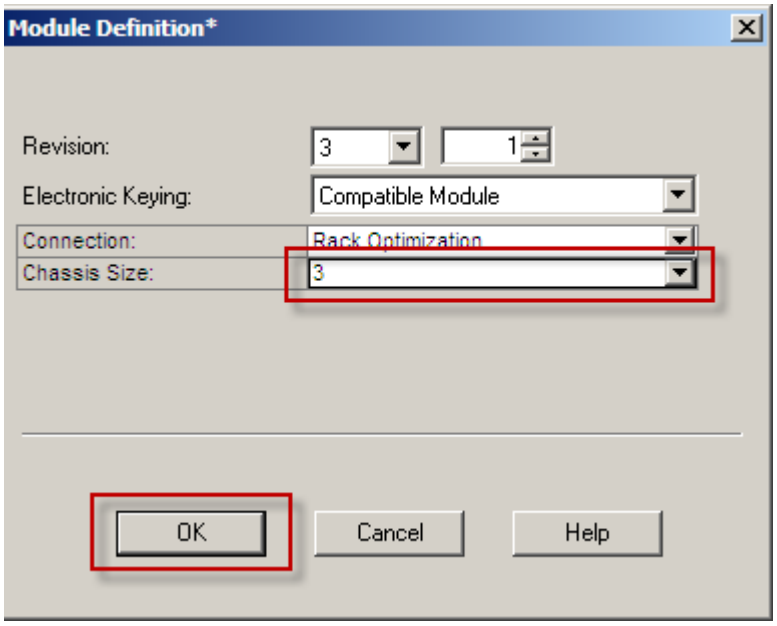


9. Click Change.

   The Module Definition dialog box appears.

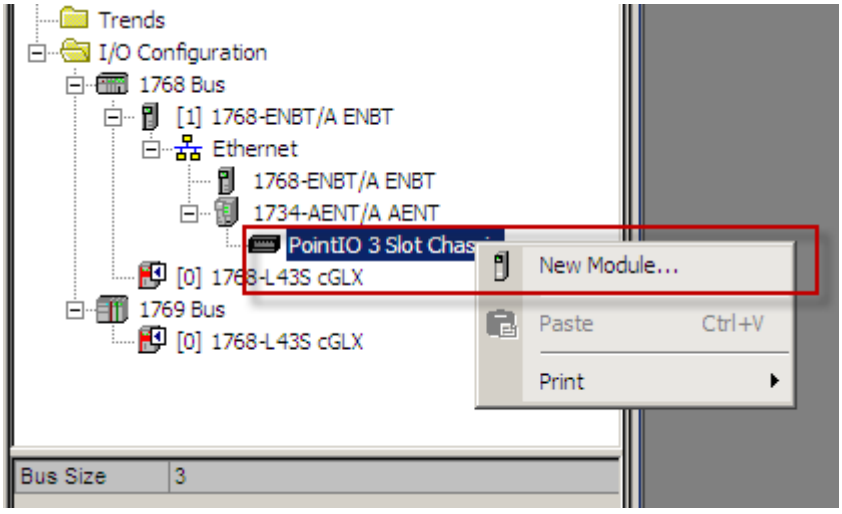
10. From the Chassis Size pull-down menu, choose 3.

    Chassis size is the number of modules that are inserted in the chassis. The 1734-AENT adapter is considered to be in slot 0; therefore, for one input and one output module, the chassis size is 3.

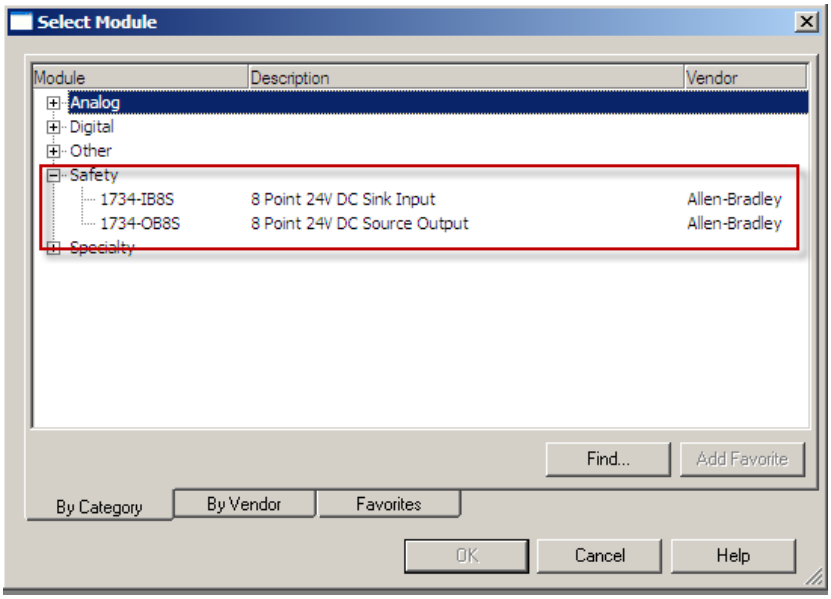


11. Click OK.

12. In the Controller Organizer, right-click PointIO 3 Slot Chassis and choose New Module.

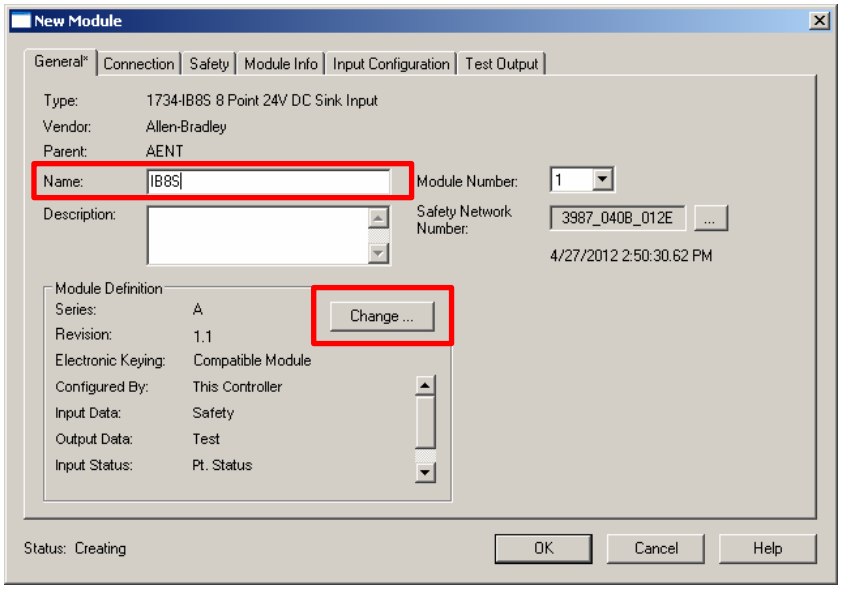


13. Expand Safety, select the 1734-IB8S module, and click OK.



The New Module dialog box appears.

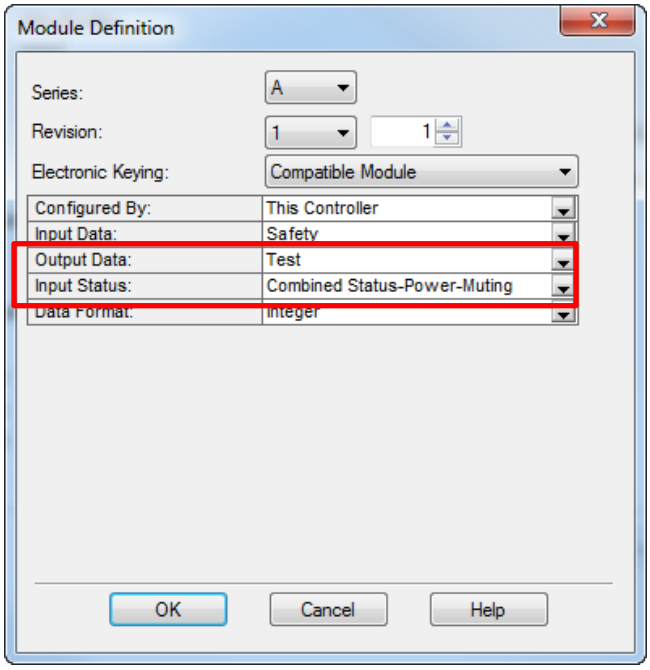
14. In the New Module dialog box, name the device IB8S and click Change.



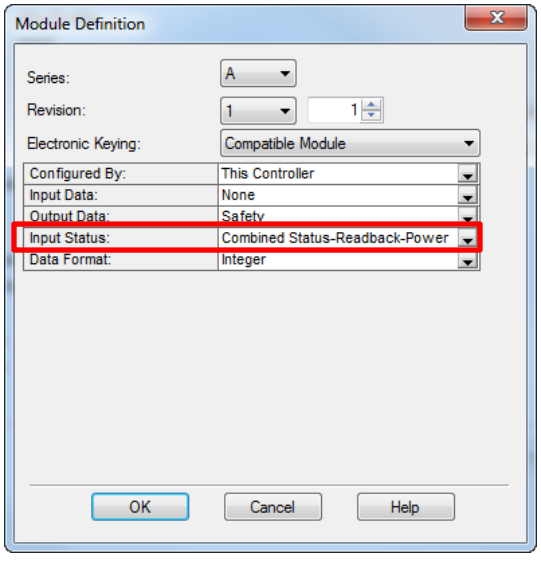
The Module Definition dialog box appears.

15. From the Output Data pull-down menu, choose Test.
16. Verify that the Input Status is set to Combined Status-Power-Muting and click OK.

    Configuring the output data for Test lets you control the test outputs programmatically, which is required for the safety mat (SMAT) instruction to source the two mat channels.



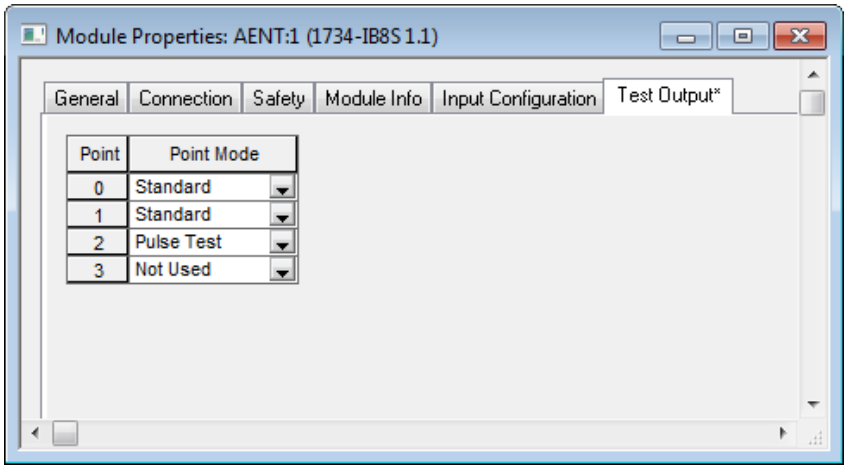
17. Repeat steps 12…16 to add the 1734-OB8S safety output module with these exceptions:
    - name the module OB8S
    - set the module to slot 2
    - set the Input Status to Combined Status-Readback-Power



Configure the I/O Modules

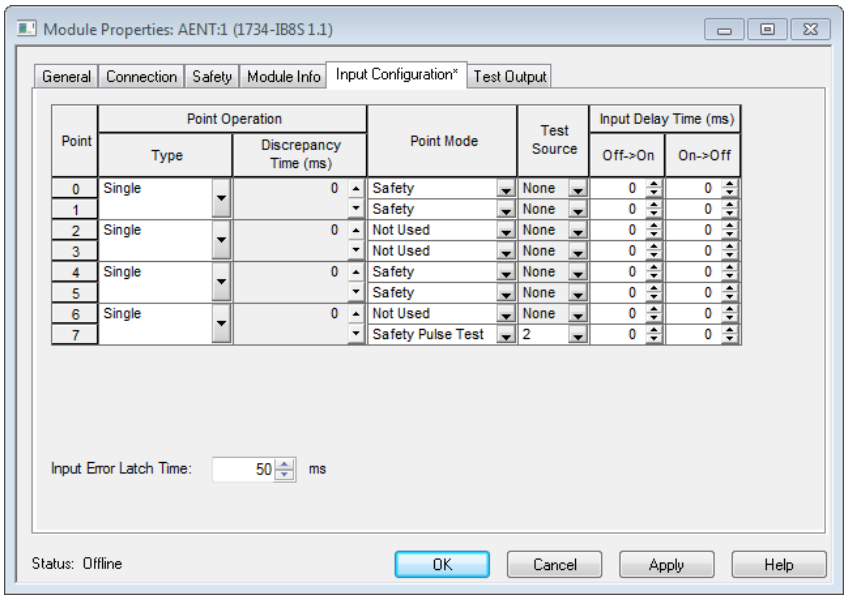
Follow these steps to configure the POINT Guard I/O modules.

1. In the Controller Organizer, right-click the 1734-IB8S module and choose Properties.
2. Click Test Output and configure the module as shown.



3. Click Input Configuration and configure the module as shown:
   - Input Points 0/1 are the Safety Mat
   - Input Points 4/5 are the Reset buttons
   - Input Point 7 is the Contactor Monitoring Circuit

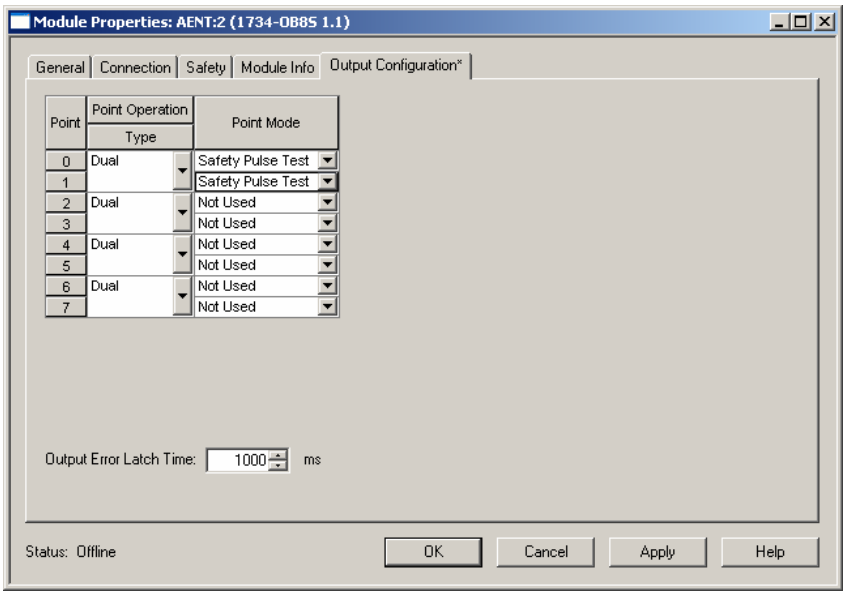
     Input Point 7 is being sourced from Test Output 2.



4. Click OK.
5. In the Controller Organizer, right-click the 1734-OB8S module and choose Properties.

6. Click Output Configuration and configure the module as shown.

   Typically, contactor coils will not react to the pulse testing of the output wires. If using a contactor that does react to the pulse test, then disable the pulse testing. This should not affect the overall safety rating if redundancy and monitoring are being used.



7. Click OK.

Programming

The safety mat (SMAT) instruction monitors dual-input safety devices whose channels short together on a typical demand.

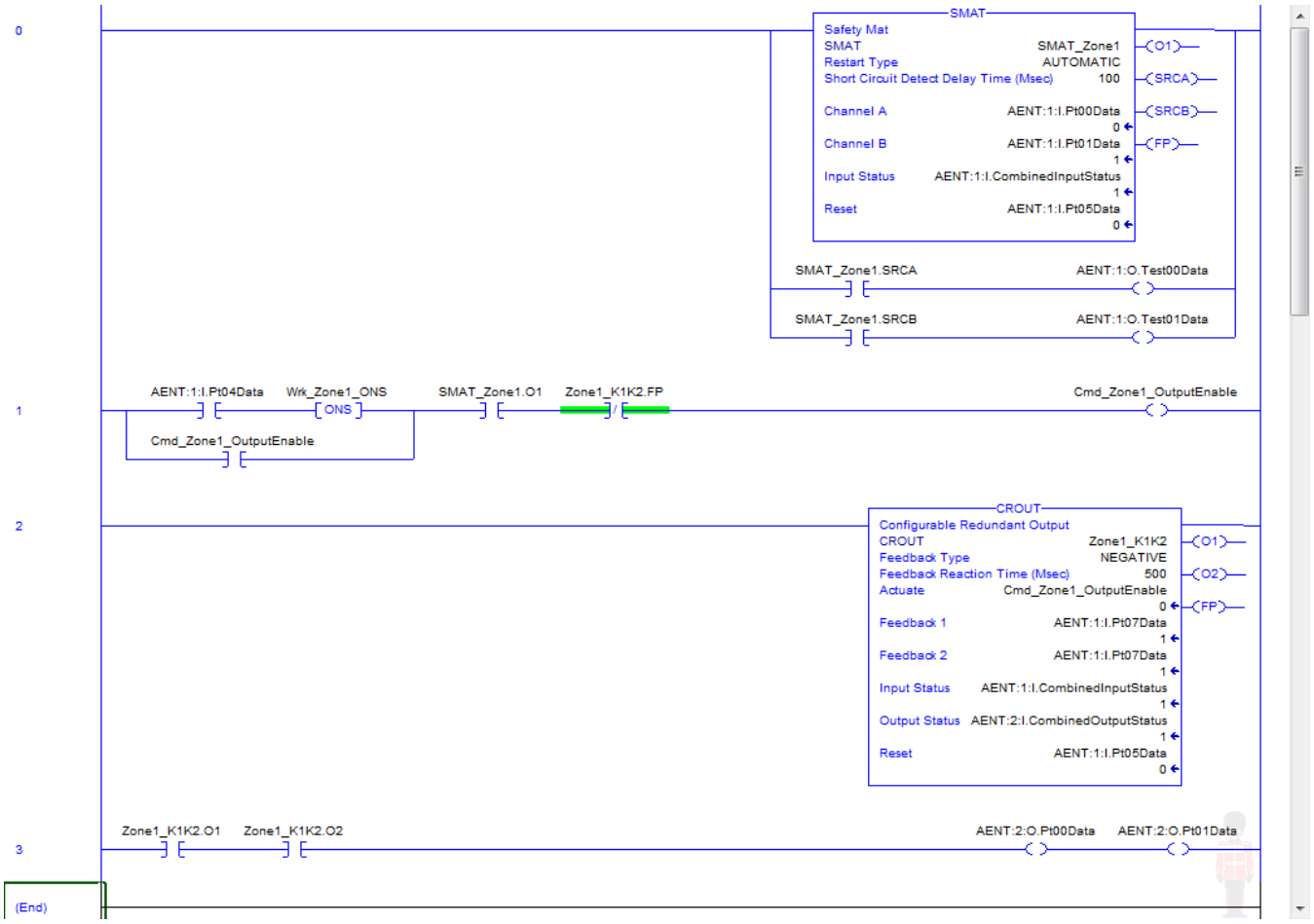
The SMAT instruction detects the difference between a normal demand (channel-to-channel short) and other faults when the short-circuit detect delay time (SCDDT) is greater than the input-module error-latch time (IELT).

The automatic restart type lets the SMAT output (O1) reset automatically after a demand. The manual action typically required for safety is provided in rung 1 to reset the safety output enable.

Input status typically represents the channel status of the two input channels. In this example, the Combined Input Status bit goes low (0) if any of the eight input channels has a fault.

In this example, the SMAT reset acts as a fault reset. Even when configured for automatic restart, a reset is required to recover from a fault. The output (O1) of the SMAT instruction is used as a safety interlock in the seal-in rung to drive the output enable tag. If the SMAT output drops out, so does the output enable, and it remains off until a manual reset action is carried out.

The Configurable Redundant Output (CROUT) instruction controls and monitors redundant outputs. Essentially, this instruction verifies that the feedback follows the safety outputs appropriately. For the negative feedback used in this example, if the outputs are high (1), the feedback is low (0) and vice versa. In this example, the feedback has 500 ms to change to the proper state. Because only a single feedback circuit is being used, the feedback tag is used for both Feedback 1 and 2.

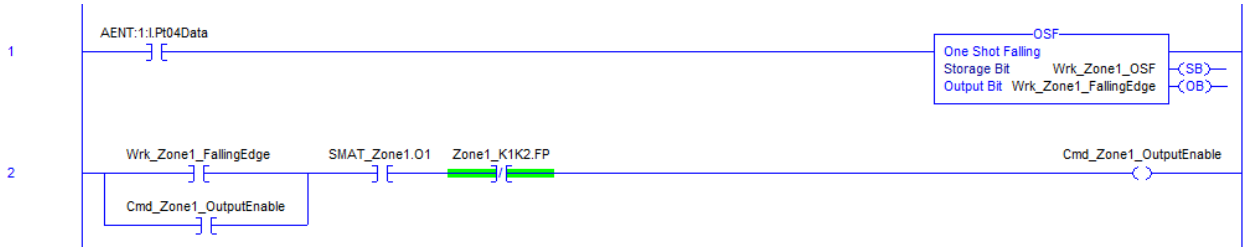


The two output tags from the CROUT instruction are used to drive the contactor outputs on the output module.

Falling Edge Reset

EN ISO 13849-1 stipulates that instruction reset functions must occur on falling edge signals. To comply with this requirement, add a One Shot Falling (OSF) instruction to the rung immediately preceding the Cmd_Zone1_OutputEnable rung, then use the OSF instruction Output Bit tag as the reset bit for the following rung. The Cmd_Zone1_OutputEnable is still used to enable the CROUT instruction.

Rung 1, above, would be replaced by the following two rungs.



Calculation of the Performance Level

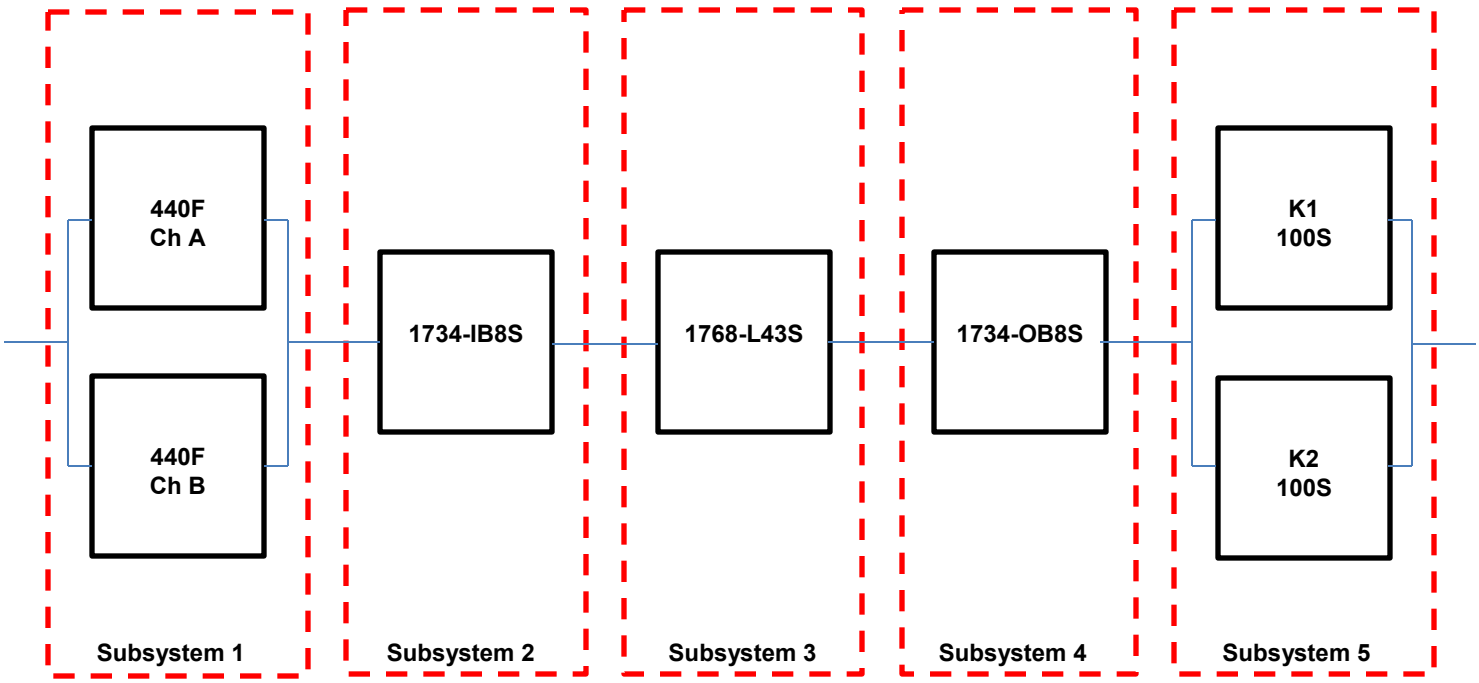
When properly implemented, this safety mat stop safety function can achieve a safety rating of Category 4, Performance Level e (CAT. 4, PLe), according to EN ISO 13849-1: 2008, as calculated by using the SISTEMA software PL calculation tool.

Individual Subsystem Values

Name	PL	PFH [1/h]	CCF score	DCavg [%]	MTTFd [a]	Category	Requirements of the category
SB POINT Guard I/O: 1734-IB8S	e	1.34E-10	*not relevant*	*not relevant*	*not relevant*	4	fulfilled
SB POINT Guard I/O: 1734-OB8S	e	1.38E-10	*not relevant*	*not relevant*	*not relevant*	4	fulfilled
SB Safety PLC: Compact GuardLo...	e	2.1E-10	*not relevant*	*not relevant*	*not relevant*	4	fulfilled
SB Contactors 100S	e	2.47E-8	65 (fulfilled)	99 (High)	100 (High)	4	fulfilled
SB Safety Mat 440F	e	2.47E-8	65 (fulfilled)	99 (High)	100 (High)	4	fulfilled

Overall Safety Functional Value

The safety mat stop function can be modeled as shown in the following safety-related block diagram.



Calculations are based on one operation of the safety mat per hour; therefore, 8760 operations of the contactors per year.

The measures against Common Cause Failure (CCF) are quantified using the scoring process outlined in Annex F of EN ISO 13849-1. For the purposes of the performance level (PL) calculation, the required score of 65 needed to fulfill the CCF requirement is considered to be met. The complete CCF scoring process must be performed when implementing this example.

Safety Mat Safety Function Subsystem 1

SB Safety Mat 440F	
PL	e
PFH [1/h]	2.47E-8
Cat.	4
MTTFd [a]	100 (High)
DCavg [%]	99 (High)
CCF	65 (fulfilled)

Safety Mat Safety Function Subsystem 2

SB POINT Guard I/O: 1734-IB8S	
PL	e
PFH [1/h]	1.34E-10
Cat.	4
MTTFd [a]	*not relevant*
DCavg [%]	*not relevant*
CCF	*not relevant*

Safety Mat Safety Function Subsystem 3

SB Safety PLC: Compact GuardLogix 1768	
PL	e
PFH [1/h]	2.1E-10
Cat.	4
MTTFd [a]	*not relevant*
DCavg [%]	*not relevant*
CCF	*not relevant*

Safety Mat Safety Function Subsystem 4

SB POINT Guard I/O: 1734-OB8S	
PL	e
PFH [1/h]	1.38E-10
Cat.	4
MTTFd [a]	*not relevant*
DCavg [%]	*not relevant*
CCF	*not relevant*

Safety Mat Safety Function Subsystem 5

SB Contactors 100S	
PL	e
PFH [1/h]	2.47E-8
Cat.	4
MTTFd [a]	100 (High)
DCavg [%]	99 (High)
CCF	65 (fulfilled)

Verification and Validation Plan

Verification and validation play important roles in the avoidance of faults throughout the safety system design and development process. EN ISO 13849-2 sets the requirements for verification and validation. The standard calls for a documented plan to confirm all of the safety functional requirements have been met.

Verification is an analysis of the resulting safety control system. The Performance Level (PL) of the safety control system is calculated to confirm that the system meets the required Performance Level (PLr) specified. The SISTEMA software is typically used to perform the calculations and assist with satisfying the requirements of EN ISO 13849-1.

Validation is a functional test of the safety control system to demonstrate that the system meets the specified requirements of the safety function. The safety control system is tested to confirm that all of the safety-related outputs respond appropriately to their corresponding safety-related inputs. The functional test includes normal operating conditions in addition to potential fault injection of failure modes. A checklist is typically used to document the validation of the safety control system.

Validation of software development is the process in which similar methodologies and techniques that are used in hardware development are deployed. Faults created through poor software development processes and procedures are systemic in nature rather than faults associated with hardware that are considered as random.

Prior to validating the GuardLogix Safety System, it is necessary to confirm that the safety system and safety application program have been designed in accordance with the GuardLogix System Safety Reference Manuals, publication 1756-RM093 (GuardLogix 5560 and Compact GuardLogix controllers) and 1756-RM099 (GuardLogix 5570 controllers), and the GuardLogix Application Instruction Safety Reference Manual, publication 1756-RM095.

GuardLogix Safety Mat Monitoring Safety Function Verification and Validation Checklist			
General Machinery Information			
Machine Name/Model Number			
Machine Serial Number			
Customer Name			
Test Date			
Tester Name(s)			
Schematic Drawing Number			
Controller Name			
Safety Signature ID			
Safety Network Number(s)			
RSLogix 5000 Software			
Safety Control System Modules	**GuardLogix Modules**	**Firmware Revision**	
GuardLogix Safety Controller	1768-L43S		
CompactLogix Ethernet Bridge	1768-ENBT		
POINT I/O™ Ethernet Adapter	1734-AENT		
POINT I/O Input Modules	1734-IB8S		
POINT I/O Output Modules	1734-OB8S		
GuardLogix Safety System Configuration and Wiring Verification			
Test Step	**Verification**	**Pass/Fail**	**Changes/Modifications**
	Verify that the safety system has been designed in accordance with the GuardLogix Control Systems Safety Reference Manual listed in the Additional Resources.		
	Verify that the safety application program has been designed in accordance with the GuardLogix Safety Application Instruction Set Reference Manual listed in the Additional Resources.		
	Visually inspect the safety system network and I/O to verify that they are wired as documented in the schematics.		
	Visually inspect the RSLogix 5000 program to verify that the safety system network and I/O module configuration are configured as documented.		
	Visually inspect the RSLogix 5000 application program to verify that the suitable safety-certified instructions are used. The logic is readable, understandable, and testable with the aid of clear comments.		
	Verify that all input devices are qualified by cycling their respective actuators. Monitor the status in the RSLogix 5000 Controller Tags window.		
	Verify that all output devices are qualified by cycling their respective actuators. Monitor the status in the RSLogix 5000 Controller Tags window.		

GuardLogix Safety Mat Monitoring Safety Function Verification and Validation Checklist (continued)

Normal Operation Verification The safety system properly responds to all normal Start, Safety Mat Input, and Reset commands.			
Test Step	**Verification**	**Pass/Fail**	**Changes/Modifications**
	Initiate a Start command. Both contactors energize for a normal machine run condition. Verify proper machine-status indication and RSLogix 5000 safety application program indication.		
	Initiate a Stop command. Both contactors de-energize for a normal machine Stop condition. Verify proper machine-status indication and RSLogix 5000 safety application program indication.		
	While the system is running, step onto the safety mat. Both contactors remain de-energized and open for a normal safe condition. Verify proper machine-status indication and RSLogix 5000 safety application program indication. Repeat for all safety mats.		
	While the system is stopped, stand on the safety mat and initiate a Start command. Both contactors remain de-energized and open for a normal safe condition. Verify proper machine-status indication and RSLogix 5000 safety application program indication. Repeat for all safety mats.		
	Initiate a Reset command. Both contactors remain de-energized. Verify proper machine-status indication and RSLogix 5000 safety application program indication.		

GuardLogix Safety Mat Monitoring Safety Function Verification and Validation Checklist (continued)			
Abnormal Operation Validation The GuardLogix safety system properly responds to all foreseeable faults with corresponding diagnostics.			
Safety Mat Input Tests			
Test Step	**Validation**	**Pass/Fail**	**Changes/Modifications**
	While the system is running, remove the channel 1 wire from the safety I/O. Both contactors de-energize. Verify proper machine-status indication and RSLogix 5000 safety application program indication. Verify that the system is unable to reset and restart with a fault. Restore channel 1 and repeat for channel 2.		
	While the system is running, short channel 1 of the safety I/O to 24V DC. Both contactors de-energize. Verify proper machine-status indication and RSLogix 5000 safety application program indication. Verify that the system is unable to reset and restart with a fault. Restore channel 1 and repeat for channel 2.		
	While the system is running, short channel 1 of the safety I/O to 0V DC. Both contactors de-energize. Verify proper machine-status indication and RSLogix 5000 safety application program indication. Verify that the system is unable to reset and restart with a fault. Restore channel 1 and repeat for channel 2.		
	While the system is running, short channels 1 and 2 of the safety I/O. Both contactors de-energize. Verify proper machine-status indication and RSLogix 5000 safety application program indication. Because this condition cannot be differentiated from a normal demand, verify that the system is unable to reset and restart with a fault. Restore channels 1 and 2 wiring.		
GuardLogix Controller and Network Tests			
Test Step	**Verification and Validation**	**Pass/Fail**	**Changes/Modifications**
	While the system is running, remove the Ethernet network connection between the safety I/O and the controller. All contactors de-energize. Verify proper machine-status indication and I/O Connection Status in the RSLogix 5000 safety application program.		
	Restore the safety I/O module network connection and allow time to reestablish communication. Verify the Connection Status Bit returns to the proper state. Repeat for all safety I/O connections.		
	While the system is running, switch the controller out of Run mode. All contactors de-energize. Return the keyswitch back to Run mode. All contactors remain de-energized. Verify proper machine-status indication and RSLogix 5000 safety application program indication.		

GuardLogix Safety Mat Monitoring Safety Function Verification and Validation Checklist (continued)

Safety Contactor Output Tests			
Test Step	**Verification and Validation**	**Pass/Fail**	**Changes/Modifications**
	Initiate a Start command. Both contactors energize for a normal machine run condition. Verify proper machine-status indication and RSLogix 5000 safety application program indication.		
	While the system is running, remove the contactor feedback from the safety I/O. All contactors remain energized. Initiate a Stop command and attempt a Reset command. The system does not restart or reset. Verify proper machine-status indication and RSLogix 5000 safety application program indication.		
	While the system is running, short the contactor feedback to the safety I/O. All contactors remain energized. Initiate a Stop command and attempt a Reset command. The system does not restart or reset. Verify proper machine-status indication and RSLogix 5000 safety application program indication.		

Additional Resources

Refer to these publications for more information about related products from Rockwell Automation.

Resource	Description
Compact GuardLogix Controllers User Manual, publication 1768-UM002	Provides information on configuring, operating, and maintaining Compact GuardLogix controllers.
POINT Guard I/O Safety Modules Installation and User Manual, publication 1734-UM013	Provides information on configuring, operating, and installing POINT Guard I/O modules.
GuardLogix Control Systems Safety Reference Manual, publication 1756-RM093	Provides detailed requirements for achieving and maintaining safety ratings with the GuardLogix and Compact GuardLogix controller systems.
GuardLogix Safety Application Instruction Set Reference Manual, publication 1756_RM095	Provides detailed information on the GuardLogix Safety Application instruction set.
GuardLogix 5570 Controller Systems Safety Reference Manual, publication 1756-RM099	Contains detailed requirements for achieving and maintaining safety ratings with the GuardLogix 5570 controller system.
Safety Accelerator Toolkit for GuardLogix Systems Quick Start Guide, publication IASIMP-QS005	Provides step-by-step guide to using the design, programming, and diagnostic tools in the Safety Accelerator Toolkit.
Safety Product Catalog, publication S117-CA001	Provides data and guidance concerning safety principals, standards component data, and application examples.

You can view or download publications at http://www.rockwellautomation.com/literature. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

For more information on
Safety Function Capabilities, visit:

discover.rockwellautomation.com/safety

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

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